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Stages of Creative Thinking Visual Male Students in Solving Geometry Problems

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Abstract

The stage of creative thinking is the process of thinking by students to generate ideas, plan, and produce a problem solving Geometry. The result of students' creative staging in solving Geometry problems can enable a smooth, flexible and new product of creativity. Phasing in creative thinking requires a way to process, organize and process information so that in solving geometry problems to be effective and efficient. The fact that occurs in elementary schools shows that educators pay less attention to triggers the occurrence of student creativity and some even underestimate the type of student learning styles. Dissolution of this student learning style raises, diminished ideas in building a completion of geometry, and even results in the lack of maturation of adequate planning, resulting in failure of students' creative products. This study aims to describe the creative thinking process of elementary school boys with visual learning style in solving geometry problems. The subjects in this study were male students with a type visual learning style. Data collection is done by providing geometry problem solving test questions to male subjects, and if at the time of completing the first problem solving test sheet there is data that is not written or not disclosed then an in-depth interview is immediately conducted on the subject, then triangulation of time is carried out by providing second problem solving test. The data that has been obtained is then analyzed by doing the transcribing, categorization, reducing, interpreting of data and drawing conclusions. The result showed that all stage of creative thinking in solving geometry problems can be done by male subjects correctly, which starts with generating ideas through reading and observing pictures and can link information that is known to the past with present information, so that the subject can identify information that is known and what is asked, and can do three different and correct planning processes, so produce true, smooth, flexible and new creativity products.

Keywords: stage of creative, Products of creative, geometry problems, style learning and male

1. INTRODUCTION

Stages in creative thinking can be said as a process of creative thinking. The process of creative thinking is steps in creative thinking that can occur because of the open geometry problem. This can trigger students to generate ideas that are directly related to the problem of Geometry, so they can choose a specific plan to solve the Geometry Problem. Furthermore, the results of solving this problem give birth to a product of creativity, which includes flexibility, fluency and novelty (Ishabu 2019). One theory that has been widely cited by researchers is Wallas's (1926) theory, among others, Solso (2008: 445) explains that Wallas describes the creative process as having four stages, namely Preparation, Incubation, Illumination, and Verification. Although there is very little support for these four stages or processes of wallas, there is still very little mathematical psychology literature that contains reports from people who have given birth to creative ideas.

Marpaung (1999: 3) states that the learning process in schools is dominated by groups who view mathematics as a product that already exists and needs to be transferred to students' minds. Such learning can result in students learning only by rote learning rather than meaningful learning. According to Schoenfeld (Boaler, 1998), teaching methods that are focused on handbooks encourage the development of students' procedural knowledge whose use is only limited to school situations. The picture that appears in the field of education, learning emphasizes more on memorization and looking for one correct answer to the questions given. Higher thought processes including creative thinking are rarely trained. This is in line with the opinion of Wallas in Solso et al, (2008: 445) that there are 4 creative stages, namely: 1) Preparation. Students need to formulate a problem and make an initial effort to solve it. 2) Incubation. The period in which students make no effort to solve the problem directly and attention to the problem, transferred for a moment to other things. 3) Illumination. Students gain insight (deep understanding) of the problem. 4) Verification. Students can review the understanding that has been obtained and make solutions. The creative process according to Wallas cannot be done in this study, because the second process is incubation which is difficult for students to solve mathematical problems.

Another expert who developed Wallas's theory, Morgan (1993) who outlines, the creative stage has three steps namely preparation, incubation and illumination, verification. Components of the creative stage according to Morgan are identical to Wallas, only at the incubation and illumination stage into one stage Furthermore, another expert who explains about the creative stage is Petty (1997), the creative process consists of six stages, namely inspiration, clarification, distillation, inspiration, evaluation and incubation. During the creative phase it must be done several times, no need to be sequential, sometimes in a very short time.

Inspiration stage is the stage of generating ideas as much as possible. This stage must be truly interested, fearless and free, spontaneous, risk-taking, happy, non-problematic, intuitive, and improvising. Next to make some ideas students need to investigate as many ideas and investigations as possible completely. The investigation was carried out not for the perfection of the formation of the idea, but for something of value. Imagination is a resource that is actually unlimited and largely unrevealed. To find as many ideas and approaches as possible it needs to be really serious, fearless and free. The clarification stage is the stage of focusing on the target. Thus the inspiration stage and the clarification stage are identical to the stage of generating ideas in Ishabu's research (2019). The distillation stage is the stage of checking the ideas that have been generated and trying to determine the work to be done. The distillation stage is the stage for selecting certain ideas, namely filtering the inspiration stage from the point of discovery and clarified. The best ideas are chosen to be developed further, combined into better ideas. Distillation is a stage of self-critical thinking. Stage that requires analysis and assessment with a cool head that not spontaneity. So the distillation stage is planning to solve problems. The perspiration stage is the stage of working out the best ideas diligently. This process is the stage in producing a solution to the problem that later gave birth to a product. Next is the incubation stage is the stage of leaving the problem temporarily and bringing the subconscious mind, although sometimes still considering it, leaving it at the beginning of the mind.

Rhodes, in Munandar (2009: 20) analyzed more than 40 definitions of creative thinking and concluded that creative thinking was formulated in personal terms, processes, press and products. Creativity or creative thinking can also be viewed from personal conditions and the environment that pushes (press) individuals to creative behavior. Rhodes calls these four as "Four P's of Creativity: person, press, process, product". Most definitions of creative thinking focus on one of these four P's or their combinations. Therefore, if someone sees the phenomenon of creativity, then it can be better seen from real works that have been produced by someone rather than seeing how the process of producing these works.

Siswono (2007), revealed that creative thinking is a combination of logical thinking and divergent thinking that occurs based on a person's intuition and awareness. Creative thinking is a thought process that uses logic and intuition together to produce something new. The indication of creative thinking in mathematics is to produce something new. Therefore, creativity in mathematics can also be seen as a mathematical creative thinking ability. According Sukmadinata (2004: 4) creative thinking is a routine of thinking that is looking for, turn on imagination, intuition, grow new potentials, opens up horizons that generate awe, stimulates unexpected thoughts. In line with this opinion Gie, L (2003) states that creative thinking is a series of actions taken by people using their intellect to create new ideas from a collection of memories that contain various ideas, information, concepts, experiences and knowledge. This understanding shows that creative thinking is marked by the creation of something new from the results of various information ideas, concepts, experiences and knowledge imprinted in his mind. The creative thinking process consists of three stages: generating ideas, planning solutions, and producing problem solving. This is in line with the opinion of Ishabu (2019) that cognitive processes in the aspect of creating include building ideas (generating), planning for completion (planning), and producing solutions (producing). Generating ideas is a divergent process that gives rise to the possibilities of solving problems. It means that, if someone is given a problem then to solve the problem, it is necessary to investigate, find out or ask questions or dig up more information based on previous learning experiences or through current learning, so that there will be a plan of resolution and finally producing problem solving.

A person's ability to learn and understand and absorb subject matter is certainly different in level. One learning style that focuses on vision is the visual learning style. In addition to focusing on vision, learning styles are more fun with the use of colors, pictures and so on. This is in line with the opinion by Waskitoningtyas (2017), a person with a visual learning style tends to focus more on the use of his visual acuity in learning. Students with this category have a tendency to observe images, make pictures in colorful shapes and so on.

This study aims to explain the stages of creative thinking of elementary school male students, with visual learning styles in solving Geometry problems. The research is focused on elementary school students because since birth humans have creative potential, this behavior can be seen from small children when drawing and making scribbles on paper or walls of houses, playing cars, playing doctors using simple tools. According to Ayan (1997) in Suharnan, (2005), that originality thinks 90% are aged 0-5 years, and 20% are in elementary school age and 2% are in adulthood. Buzan (2004) found that the percentage of creative age groups 70-90% were in kindergarten age, while 50-70% were in elementary school age and the rest were in middle school age to college students. The

research above became the reason for researchers to conduct further research on the creative thinking process of male students in the Darar School in solving Geometry problems.

2. RESEARCH METHOD

This research is explorative in nature which aims to explore students' creative thinking processes in solving problems. To obtain a description of the students' creative thinking processes in solving geometry problems, an open ended geometrical problem solving test is given. Before solving the problem, the researcher conducted an interview with the teacher in the classroom to find out the students 'abilities, with the criteria for the students' ability scores between 75 and 84, 5. Next students work on the Learning Style Test, and then the researcher chooses one student who has a visual learning style to be the subject of the study. When working on the Geometry Problem Resolution Test. Researchers conduct interviews around the subject's readiness in generating ideas, planning and producing problem solving that is expected to meet aspects of students' creative products. Test results, and interviews from the subject, will be analyzed in depth based on indicators of the creative thinking process, and the subject's creative products.

To recognize the characteristics of this study, the first research design was natural, with the main data source being the male subject of Primary School Class V, with visual learning styles. The main instruments in this study are researchers who act as interviewers and examiners of test results. Second, the data collected in the form of information (a collection of statements) provided by the data source, in response to the stimulus provided by researchers. Third, this research emphasizes "how students' creative thinking processes" and why it is thought, by the data source of the product produced. Fourth, the data collected in this study is how the elementary school students' creative thinking processes solve problems, without special treatment beforehand.

Data collection instruments used in this study consisted of: a) Student learning style tests b) Problem Solving Test c) Interview guidelines; and d) Recorders, audio visual. All test kits are validated by three experts in the field of mathematics and one class teacher who is an expert in their field.

After the data is collected, a data consistency check is performed using time triangulation. If there is inconsistent data, then data retrieval can be done again to perfect the previous data.

The data that has been obtained is then analyzed which starts by conducting data transcripts, written work results and interview results. Data transcripts are performed based on the results of the recording and the results of the subject's work. Then the data is coding, this step is taken to facilitate the categorization and keep the data within the research objectives. After the data transcript is complete, the data reliability test is then performed, to obtain reliable data (consistent) and then the data is analyzed. Stages of data analysis in this study include; Data categorization, data reduction, data interpretation, and drawing conclusions.

3. RESULT AND DISCUSSION

Data collected in this research are in the form of written work of male subjects with visual learning styles as well as recorded in-depth interviews of the subject. Retrieval of the data from male and female subjects with Visual Learning Styles taken in twice.

Based on the results of data analysis, it can be explained the creative thinking process of male subjects with visual learning styles in solving Geometry problems by paying attention to the subject's creative process which includes generating ideas, planning the problems solving and producing the problem solving.

3.1 Generating ideas

The results of observations and interviews with the subject at the time of solving the problem show that the subject reads the problem twice in the heart and observes a right-angled Trapezoid Image on the problem. This activity can generate ideas in the form of identifying what information is known from the problem by connecting past knowledge with current knowledge. This can be known from the researcher’s interview excerpts with the following subjects.

Researcher	Please do this problem correctly, but before you do it, read the problem first! (Researchers give questions to the subject accompanied by a sheet to answer)
Male subject	Yes sir! (The subject reads the question silently until it's finished.)

Researcher	What is known to the problem? Please explain that.
Male subject	Jamal's soil is in the form of a right-angled trapezoid like the picture in this question, long AD = 60 meters, AB = 45 meters, and BC = 20 meters. The land will be inherited by his two children, each of which must have the same size.
Researcher	Have you ever had a problem like that before? Explain that.
Male subject	Yes, but we learn the usual division, for example dividing bread into two equal parts, or dividing a plate of rice into two parts.

3.2 Planning Problem Solving

Planning begins by drawing a trapezoid as the problem given by the researcher. Then form a trapezoid into a rectangle, then divide the length and width into three and two, respectively. The following are excerpts from interviews and researchers' observations of male subjects, as follows.

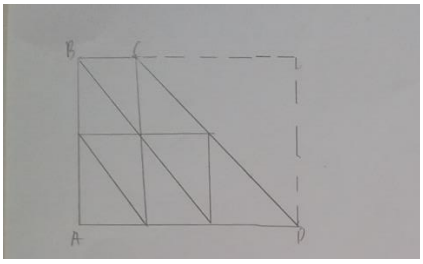
Researcher	Okay, how do you plan to solve that problem?
Male subject	First, I will make a right-angled Trapezoid into a rectangle, 60 m long and 45 m wide. Then for a length of 60 m I will divide by three and a width of 45 m by 2, then based on these measurements I make plots, such as rice fields, and then I will count the number of plots for each child, then I will determine the area of the first part of child is equal to the area of the second child.
Researcher	Are there other different plans to complete the division of Mr. Jamal's estate for his two children?
Male subject	Yes sir. But there is still using the first plan based on the first plan that the subject gives four maps to the first child, thus forming a parallelogram and giving four maps to the second child, thus forming a right triangle.
Researcher	Are there any other plans that are different from before to complete the division of Mr. Jamal's estate for his two children?
Male subject	Look sir. This is the same as the first and second ways, but we put the right triangle with a base of 20 m and a height of 22.5 m in different places, in the first and second way, then count each child to get 4 right triangle the small elbows, then determine the number of right-angled triangle parts of the first child the same as the second child part.

Based on the interview passage above, it can be seen that the subject will make a right-angled Trapezoid, then to make it easier to divide the garden, the subject will make the Trapezoid into a rectangle, and divide the length of 60 m and width of 45 m each into three and two, so there are forming six rectangles measuring 20 m long and 22.5 m wide inside the rectangle. Furthermore, based on these measurements the subject will make diagonals, so that twelve right triangles are formed inside a rectangle 60 meters for long and 45 m for wide. But from the twelve right angles, Mr. Jamal as the owner of the garden, there are only eight right angles that belong to him.

3.3 Producing Problem Solving

Based on the plan that has been made, then the subject completes according to the following interview passage.

Researcher	How do you solve this problem?
Researcher	I made it like this, Sir! (Male subject makes artificial image 1)



(Artificial Image 1)

Researcher Bagaimana penyelesaian selanjutnya?

Male subject The next solution, I give each of four plots. The first child is given four rectangular-shaped maps and the second child is four right-angled square-shaped maps, such as (Figure P1).

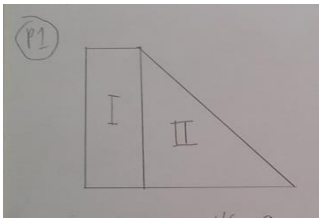


Figure P1

Researcher Do the two children have the same area?

Male subject Yes sir, it's the same, because the child part I got four rectangular-shaped maps with length (p = 20 meters) and width (l = 45 meters), So the area of the first child L1 = p x l = 20 x 45 = 900 m2. Then the second part of the child gets four right-angled triangles, with a base (a = 40 mater), height (t = 45 meters), so the area of the second child part is L2 = $\frac{axt}{2} = \frac{40x45}{2} = 900$ m^2. So the area of the first child is the same as the area of the second child.

Researcher What is the other solution to completing the division of Pak Jamal's estate to his two children?

Male subject It is enough that I give four maps to the first child, so that I form a parallelogram and give four maps to the second child, so that they form a right triangle, like a shape (Figure P2).

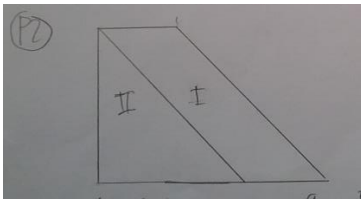


Figure P2

Researcher Is the same area between the first child part and te second child part?

Male subject Yes, it is. The first part of the child is a parallelogram, with a base = 20 meters, and height = 45 meters, so that the area of L1 = a x t = 20 x 45 = 900 m2. Then the second part of the child is a right triangle with a base (a = 40 meters) and height (t = 45 meters), so it has area L2 = $\frac{axt}{2} = \frac{40\ meter\ x\ 45\ meter}{2} = \frac{1.800}{2} = 900$ m^2. So it is equal between area L1 and area L2

Researcher Then how else could it be different from before, to complete the division of Mr. Jamal's garden land for his two children?

Male subject The method is like this, sir. (S shows the picture that he made)

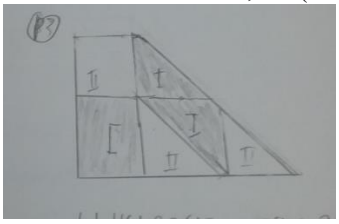


Figure P3

Researcher Explain and give the solution about picture P3!

Male subject	The first child part I and the second child part II get 4 small right triangle for each, but the part of child I gets shaded place, while the second part of child who is not shaded like picture P3.
Researcher	Does the section between the first child and the second child have the same area?
Male subject	That's right, Sir! On the small triangle, the elbows, base for each (a = 20 meters), and height (t = 22.5 meters). So the large is L= $\frac{axt}{2} = \frac{20\ meter\ x\ 22{,}5\ meter}{2}$ = 225 m ^{2}, so that 4 small right triangles is = 4 x 225 m^2 = 900 m^2.

Based on the interview excerpt above, it can be explained that the subject did the division of Pak Jamal's estate with three different solutions, the first and second subjects divide by giving four right-sized triangles with a base size of 20 m and a height of 22.5 m to the first child, each rectangular and parallelogram. In the second child section, each gets a right triangle as can be seen in Figures P1 and P2. Then the subjects divide the third way by each getting one rectangle that is 20 m long and 22.5 m wide, and two right triangles with a base size of 20 m and a height of 22.5 m, so that the area of the two children is the same, as shown in Figure P3.

3.3.1 Aspect of Fluency

A subject can be said to fulfill the indicator of fluency if the solution to the problem of Geometry can allow more than one correct answer to be answered. If related to the settlement above, it can be explained that, the first way, the subject resolves mathematical problems correctly and smoothly which begins by sketching the Trapezoid, then to facilitate the division of Mr. Jamal's Gardens in the form of a Trapezoid, the subject turns the trapezoid into a rectangle with a length and width of 60 m and 45 m respectively. Then divide the length and width of the rectangle into three and two parts, based on these measurements then connected by lines to form six rectangles, but four the rectangles in Mr. Jamal Land in the form of a Trapezoid, then the subject connects diagonally to form eight congruent right triangles. If divided into two children, Mr. Jamal, each child will get four congruent right triangle sections. Furthermore, for the four congruent triangles can be formed into rectangles and parallelogram which is the first child part while in the third way each child gets one rectangle and two right triangles that are congruent as well.

Thus there are three different ways in dividing Mr. Jamal's garden for his two children, so it can be said that the subject has produced a product that fulfill the aspect of fluency.

3.3.2 Aspect of Flexibility

Problem solving Geometry that fulfill the flexibility indicator, if students in solving mathematical problems can use a variety of approaches (more than one) correctly. Based on the problem solving above, it appears that the subject has used three different approaches in problems solving, correctly and completely. Thus the subject of Men with visual learning styles has fulfilled the flexibility aspect.

3.3.3 Aspect of Novelty

A subject is said to fulfill the aspect of novelty if students can solve Geometry problems correctly and there is one different answer, true and not commonly done or completed by students at the stage of development or level of knowledge. Based on the results of the settlement above, the subject has the right ideas, so that gave birth to the right planning and can also produce new products at the level of knowledge, so that the subject can be said to fulfill the aspect of novelty.

The stages and products of creative thinking of male subjects with visual learning styles in solving Geometry problems are summarized as follows.

Table 3.1
Summary of Stages and Products of Creative thinking of male subjects with visual learning styles in solving Geometry problems

Aspect	**Description of the creative thinking process**		
Generating Ideas	The subject reads the problem and observes the picture in the problem, so that ideas can be generated by identifying known information and also can link knowledge in the past with present knowledge so that it can easily plan solutions correctly and completely.		
Planing Problem solving	Subjects carry out planning in three different ways. The first plan is almost the same as the second plan, namely, in the first planning the subject will form a Trapezoid into a rectangle with a length and width of 60 m and 45 m respectively, and then will divide the length and width each by three and two, so that 4 rectangles are formed inside the Trapezoid. Next connect with the diagonal, so that it forms 8 congruent right triangles, and if divided in half, each child will get 4 congruent right triangles. Then based on these measurements the subject divides into rectangles, parallelograms and right triangles.		
Producing problem Solving	**Product Description Creative thinking**		
	Aspect of fluency	**Flexibility**	**Aspect of Novelty**
	The subjects produce three different and correct solutions, so it can be said to fulfill the aspects of fluency	The subject also produced three different and correct approaches, so it can be said to fulfill the flexibility aspect	The subject fulfills aspects of fluency and flexibility and there is a unique and correct solution, so it can be said to fulfill the aspect of novelty.

4. Discussion about Research of Result

Stages of creative thinking in problems solving Geometry is generally based on two indicators namely indicators that lead to the stages of creative thinking and indicators that lead to creative products.
Based on the results of the research above shows that the stages in creative thinking in solving Geometry Problems it appears that the subject reads the problem several times silently until finished and also observes the Trapezoidal Image on the problem, so that it can come up with ideas (generating ideas) by connecting the knowledge gained, correctly identify and complete information that is known from the problem, and can visually be shown with the initial design drawings namely by making rectangular-shaped plots in the land owned by Mr. Jamal, in the form of the Trapezoid, this is the initial design in planning the problem solving. Based on the problem solving plan, then the subject resolves the problem by giving four rectangular maps with a length of 20 m and a width of 22.5 m which are congruent, so with these maps, rectangles, parallelograms, and right triangles are formed in the Trapezoid as in the results of the study above. Thus it looks right at the stages in producing problem solving. This is in line with the opinion by Krathwohl and Anderson in (Farda D. K., 2012) that the stages in creative thinking must go through three steps in creative thinking, namely generating ideas, planning problem solving, and producing. Siswono (2004) states that creating has the meaning of putting elements together to form a whole that functions to rearrange the elements into a new pattern. Creating is associated with three cognitive processes, namely generating, planning, and producing. These three cognitive processes are identical to the creative thinking process. Next Suharnan, (2005), gives an example of the stages of creative thinking as follows. When someone reads a book, information is received through various stages ranging from the sensory process to memory. This information then transformed to produce what is called essence as new information, and this also means new knowledge for the person. Unlike the case with the opinion of Wallas in Sari, A.P. (2017), that the creative thinking process developed by Wallas (1926) is one of the most commonly used theories for knowing the creative thinking process which includes four stages namely preparation, incubation, illumination, and verification. Creative products are based on creative processes especially stages (producing problem solving). Based on the results of solving mathematical problems it can be concluded that the subject of Men with visual learning

styles produces creative products that fulfill aspects of fluency, flexibility and novelty. Subjects able to make approaches through making different images have the ability to think flexibility for example to think in many different categories or approaches, using their knowledge and inspiration (DePorter, Bobbi & Hernacki Mike, 2000). This can be seen from the results of the settlement showing that the subject uses three different and correct approaches in problems solving, The subject can also produce creative products fulfill the aspect of fluency, aspect of flexibility, and aspect of novelty. This is in line with the opinion by Fisher (1995) that creative thinking is a divergent ability to think that includes fluency is thinking with many ideas, flexibility is thinking in many different categories or approaches, originality is to think with ideas that are not public, and Elaboration is to apply ideas to be clearer.

5. Conclusion

Based on the results of the study it can be concluded that the subject of Men with visual learning styles fulfill the Creative Stages Indicator namely a) generate ideas through reading and observing the picture carefully on the problem so that ideas arise to identify information that is known and understand the problem completely and correctly, b) the subject does the planning that begins by making a trapezoidal image, then to facilitate completion of dividing the trapezoid into sections, then calculate and determine the area of each child, c) the next process is to produce a solution to the problem. Whereas the subject's creative products in fulfill the aspect of flexibility, but does not fulfill in aspect of fluency and aspect of novelty.

6. Thanks to

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